Occurrence of Organic Wastewater Contaminants in New Jersey's Streams and Drinking-Water Supplies

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Organic Wastewater Compounds

- Manufactured and used in large quantities,
- Potentially associated with domestic, industrial, or agricultural wastewaters,
- Examples: pharmaceuticals, antibiotics, hormones, personal care products, disinfectants, flame retardants, plasticizers, and other commercial and industrial products,
- Diversity of uses and origins,
- Variety of environmental pathways.


DISCHARGE SERIAL
NUMBER 001
NJPDES NUMBER
NJ 0024759
DEP HOT LINE
609-292-7172
EWING - LAWRENCE
SEWERAGE AUTHORITY
Primary Source(?)

Target Compounds - Antibiotics

(Tandem SPE and LC/ES-MS in positive-ion mode w/ SIM)

Tetracyclines

- Tetracycline
- Chlortetracycline
- Oxytetracycline
- Doxycycline
- Demeclocycline
- Minocycline

Fluoroquinolones

- Ciprofloxacin
- Enrofloxacin
- Norfloxacin
- Sarafloxacin

Macrolides

- Erythromycin-H_2O
- Roxithromycin
- Tylosin

Sulfonamides

- Sulfadimethoxine
- Sulfamerazine
- Sulfamethazine
- Sulfamethizole
- Sulfamethoxazole
- Sulfathiazole

Others

- Trimethoprim
- Carbadox
- Virginiamycin
- Roxarsone
- Methotrexate
- Lincomycin

Target Compounds - Human Prescription and Nonprescription Drugs

(SPE and HPLC/ES-MS in positive-ion mode w/ SIM)

Prescription	Non-prescription and Metabolites
Carbamazepine (anticonvulsant)	1,7-dimethylxanthine (caffeine metabolite)
Cimetidine (antacid)	Acetaminophen (antipyretic)
Codeine (analgesic)	Caffeine (stimulant)
Diltiazem (antihypertensive)	Cotinine (nicotine metabolite)
Diphenhydramine (antihistamine)	Dehydronifedipine (nifedipine metabolite)
Fluoxetine (antidepressant)	Digoxigenin (digoxin metabolite)
Furosemide (diuretic)	Ibuprofen (antiinflammatory)
Gemfibrozil (antihyperlipidemic)	Ranitidine (antacid)
Miconazole (antifungal)	
Salbutamol (antiasthmatic)	
Sulfamethoxazole (antibiotic)	
Thiabendazole (fungicide)	
Trimethoprim (antibiotic)	
Warfarin (anticoagulant)	

Target Compounds – Industrial and Household-use Chemicals

(CLLE and GC/MS w/ SIM)

Fragrances and Flavorants

- AHTN
- HHCB
- 3-methyl-1H-indole (skatol)
- Acetophenone
- Camphor
- Isoborneol
- Isoquinoline
- Menthol

Flame Retardants

- tri(2-chloroethyl) phosphate
- tri(dichlorisopropyl) phosphate
- tributyl phosphate

Antioxidants

- 5-methyl-1H-benzotriazle
- 3-tert-butyl-4-hydroxyanisole (BHA)

Fuel-Related Compounds

- 1-methylnapthalene
- 2,6-dimethylnapthalene
- 2-methylnapthalene
- Isopropylbenzene (cumene)

Detergent Metabolites

- 4-cumylphenol
- 4-n-octylphenol
- 4-nonylphenol diethoxylate (NPEO2)
- 4-octylphenol diethoxylate (OPEO2)
- 4-octylphenol monoethoxylate (OPEO1)
- 4-tert-octylphenol
- ρ-nonylphenol (total, NP)

Plasticizers

- Bisphenol A
- tri(2-butoxyethyl) phosphate
- triphenyl phosphate

Disinfectants

- Triclosan
- Phenol

Solvents and Preservatives

- Isophorone
- Tetrachloroethylene
- ρ-cresol
- Pentachlorophenol

Target Compounds – Industrial and Household-use Chemicals (Cont.)

(CLLE and GC/MS w/ SIM)

Pesticides

- Bromacil
- Carbaryl
- Carbazole
- Chlorpyrifos
- Diazinon
- d-dichlorvos
- d-limonene
- Indole
- Metalaxyl
- Metolachlor
- N,N-diethyl-meta-toluamide (DEET)
- Prometon

Plant and Animal Steroids

- 3-β-coprostanol
- β-sitosterol
- β-stigmastanol
- Cholesterol

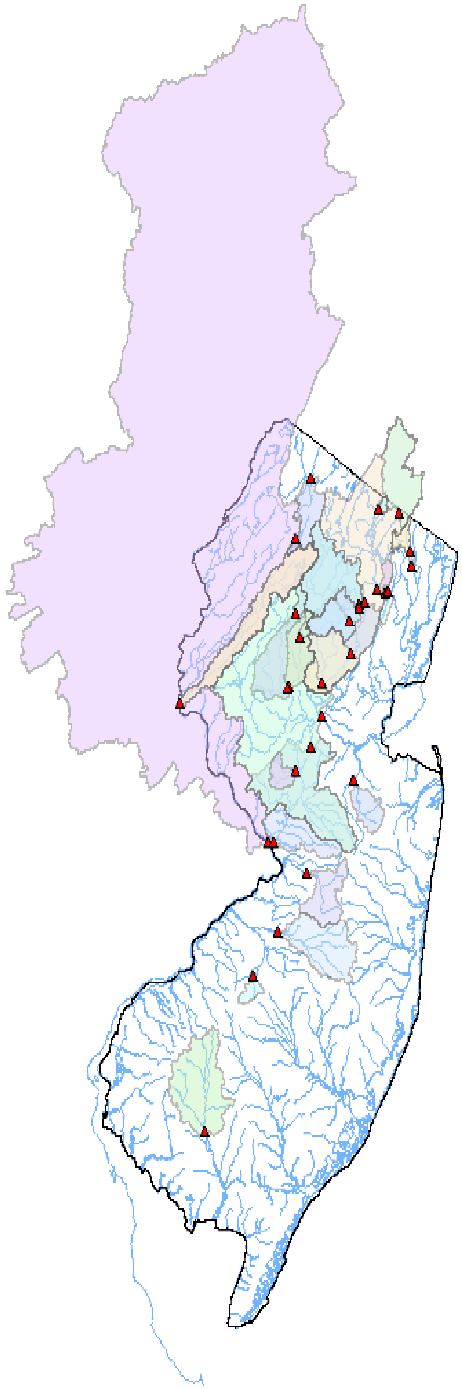
PAHs

- Anthracene
- Benzo[a]pyrene
- Fluoranthene
- Naphthalene
- Phenanthrene
- Pyrene

Others

- Anthraquinone (manufacturing)
- 1,4-dichlorobenzene (deodorizer)
- Benzophenone (fixative)
- Bromoform (disinfection byproduct)
- Caffeine (stimulant)
- Cotinine (nicotine metabolite)
- Methyl salicylate (liniment)
- Triethyl citrate (ethyl citrate) (cosmetics)

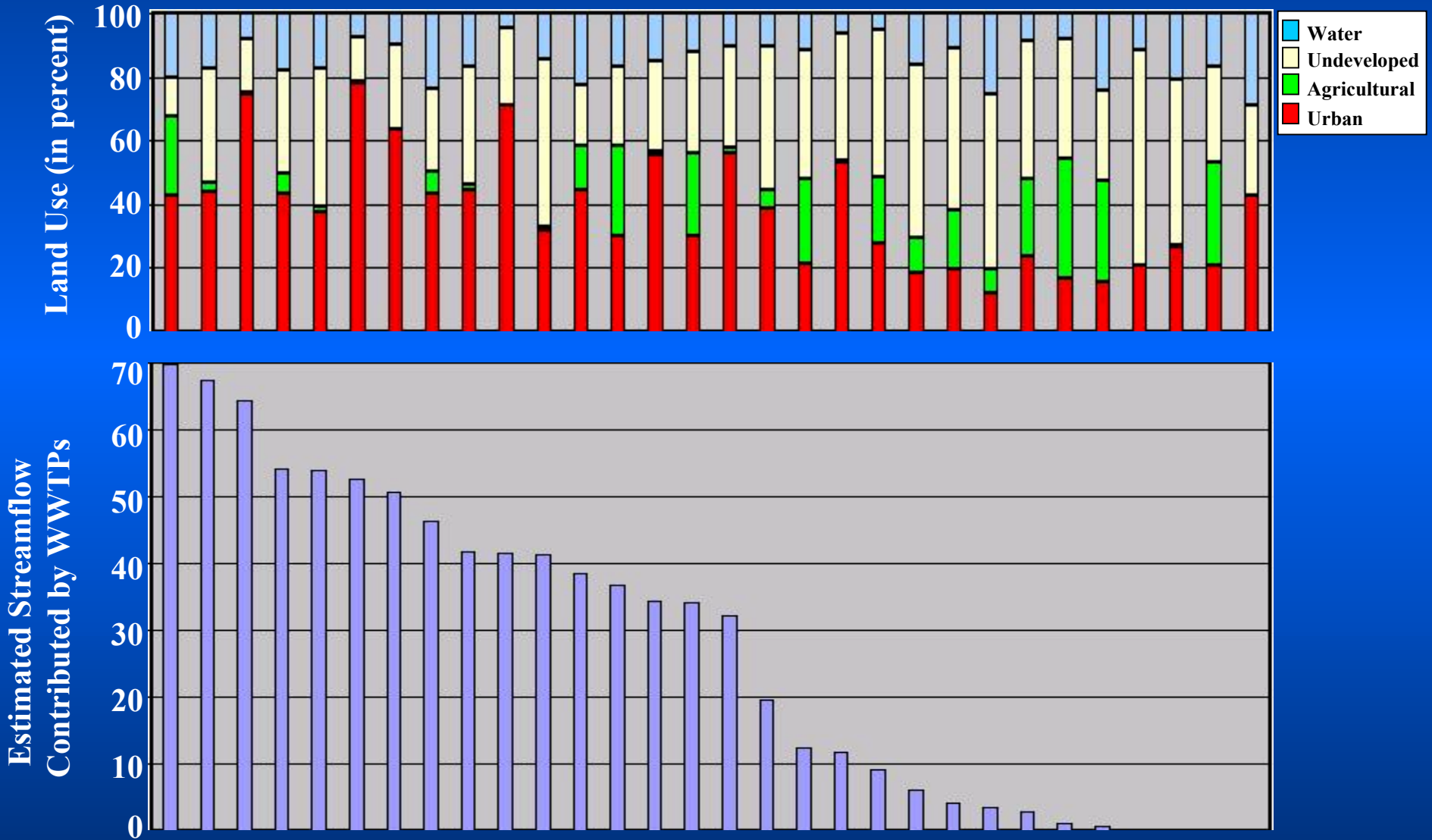
Synoptic Survey (Sampling Sites)



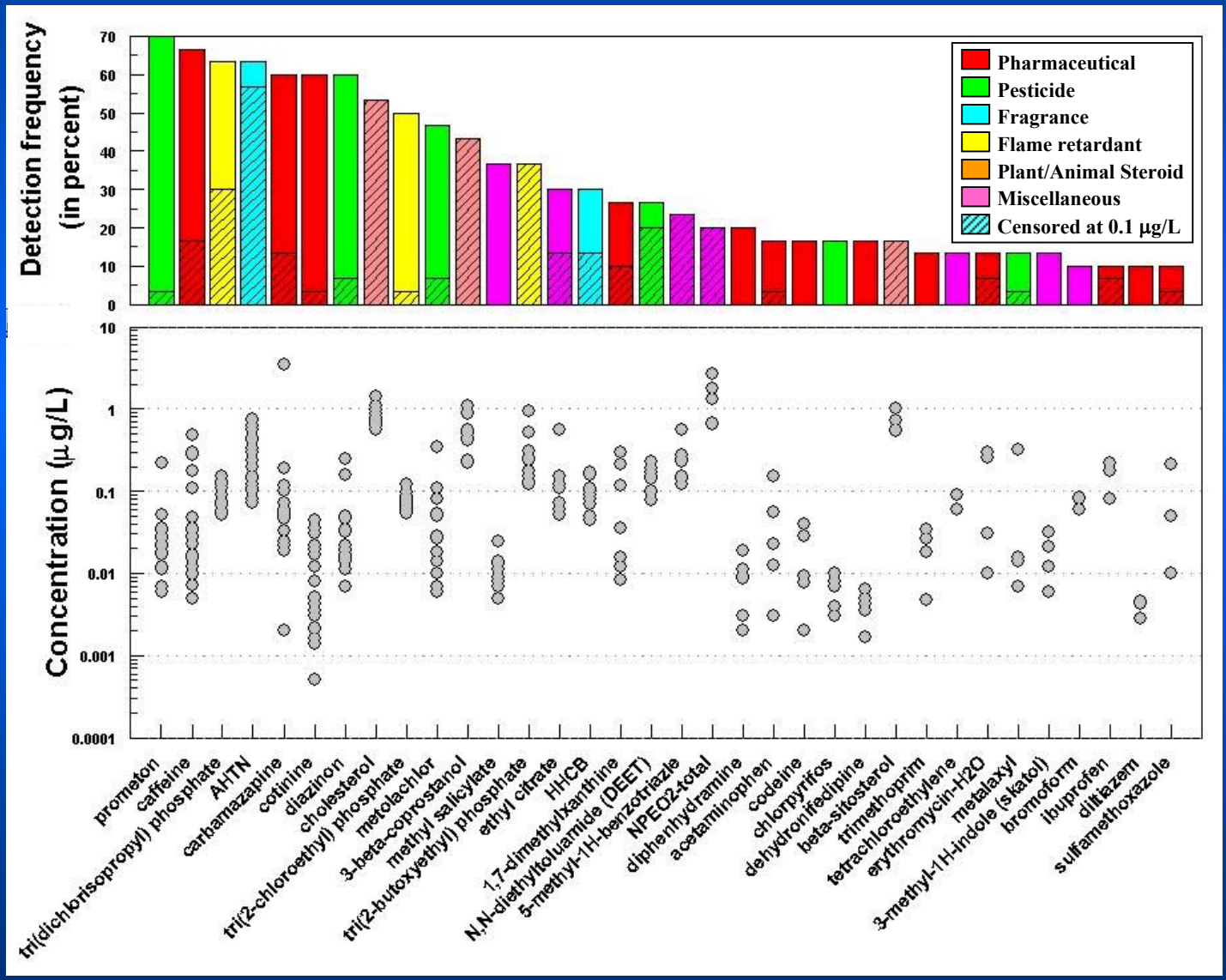
Assunpink Ck @ Trenton
Passaic R @ Pine Brook
Hohokus Bk @ Mouth @ Paramus
Dead R nr Millington
Passaic R @ Little Falls
Hohokus Bk @ Ho-Ho-Kus
Singac Bk @ Singac
Passaic R nr Chatham
Lamington R (Black R) nr Ironia
Peckman R @ West Paterson
Rockaway R @ Pine Brook
Matchaponix Bk @ Spottswood
Millstone R @ Blackwells Mills
Whippany R nr Whippany
Raritan R @ Queens Bridge

Whippany R nr Pine Brook
N. Branch Raritan R nr Chester
Beden Bk nr Rocky Hill
Ramapo R nr Mahwah
N. Branch Raritan R @ Burnt Mills
Wallkill R nr Sussex
Musconetcong R @ Riegelsville
N. Branch Rancocas Ck @ Ewanville
Lamington R (Black R) @ Burnt Mills
Delaware R @ Trenton
Crosswicks Ck @ Extonville
Cupsaw Bk nr Wanaque
Maurice R nr Millville
Wallkill R @ Lake Mohawk @ Sparta
Haynes Ck @ Lake Pine

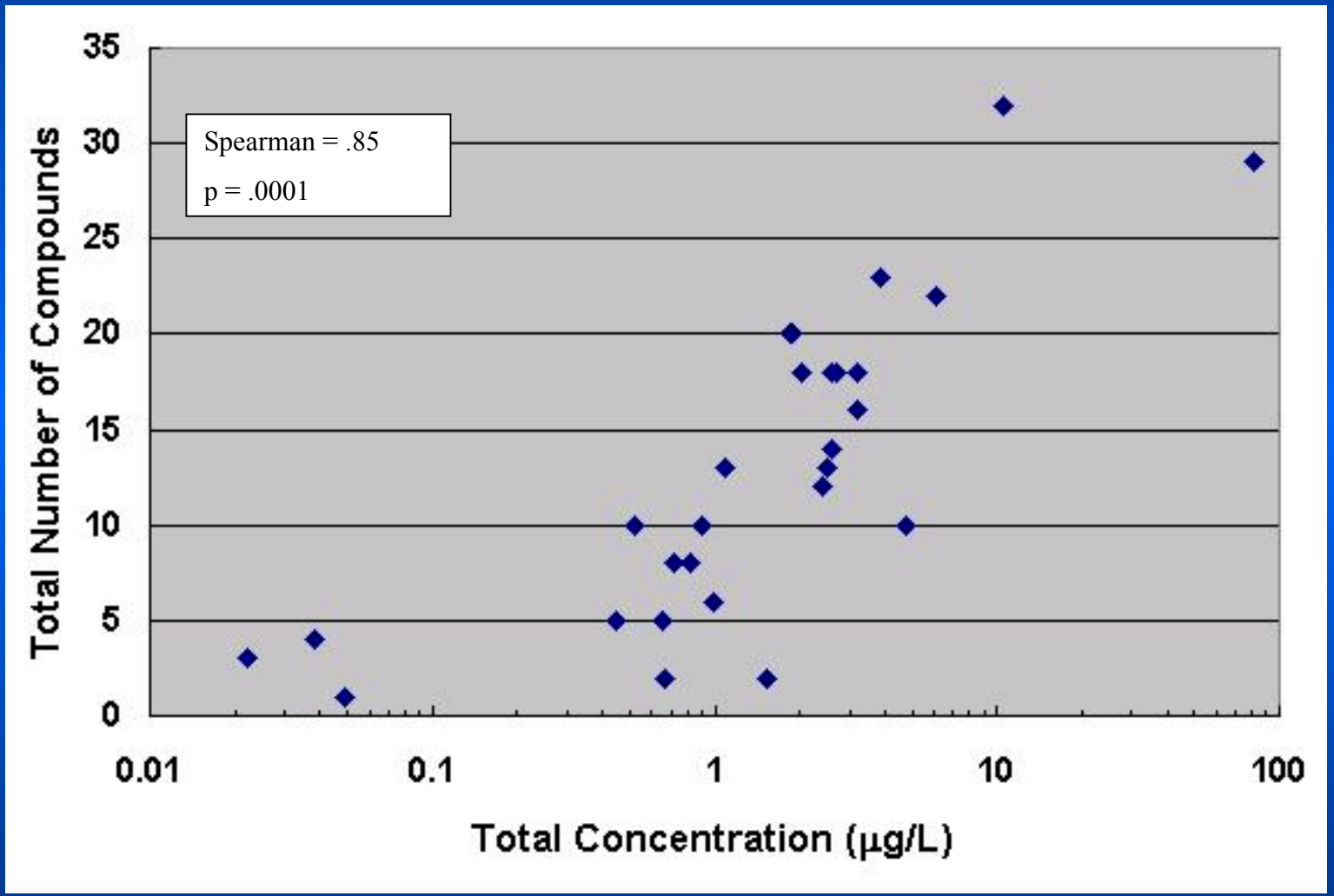
Vulnerability Gradient



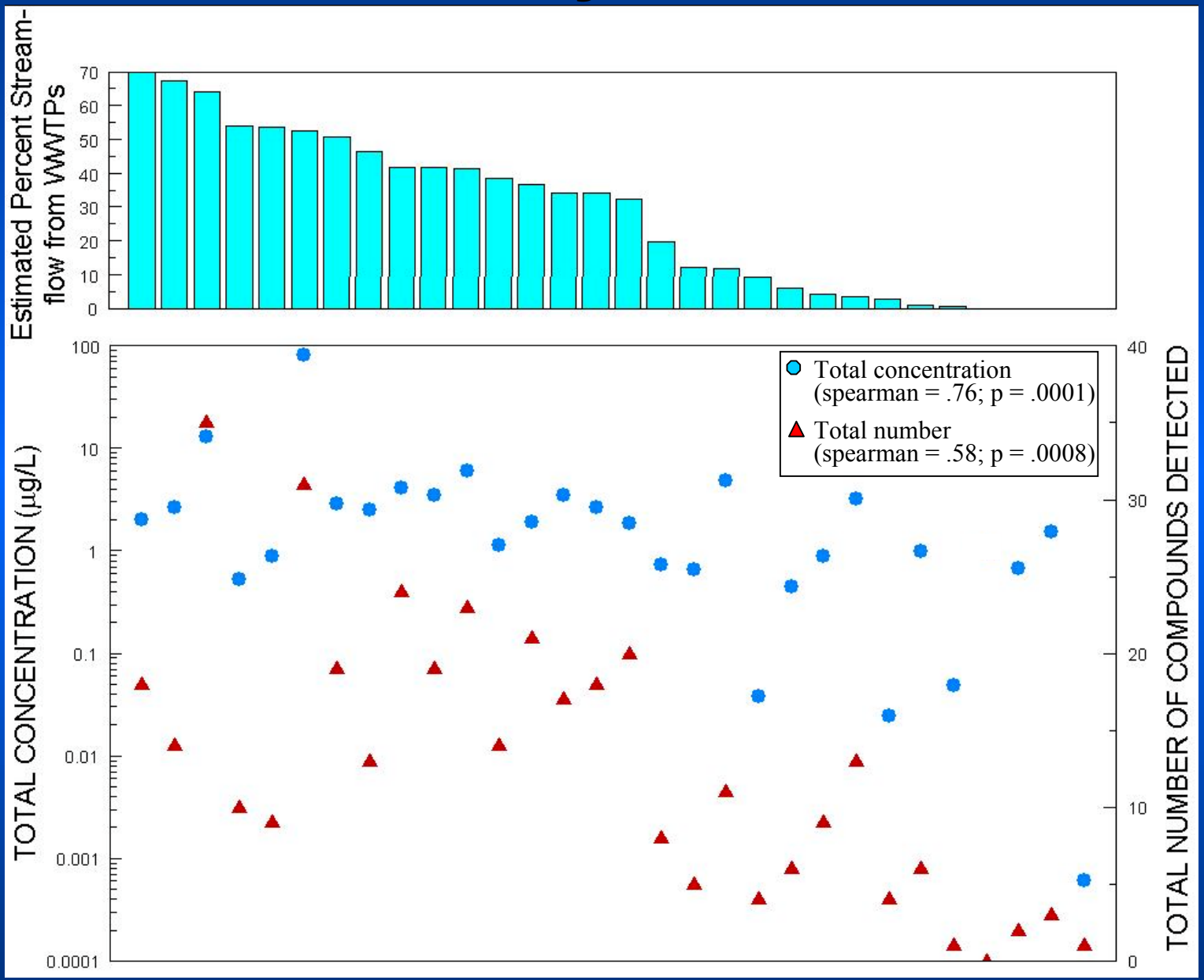
Most Frequently Detected Compounds (synoptic survey)



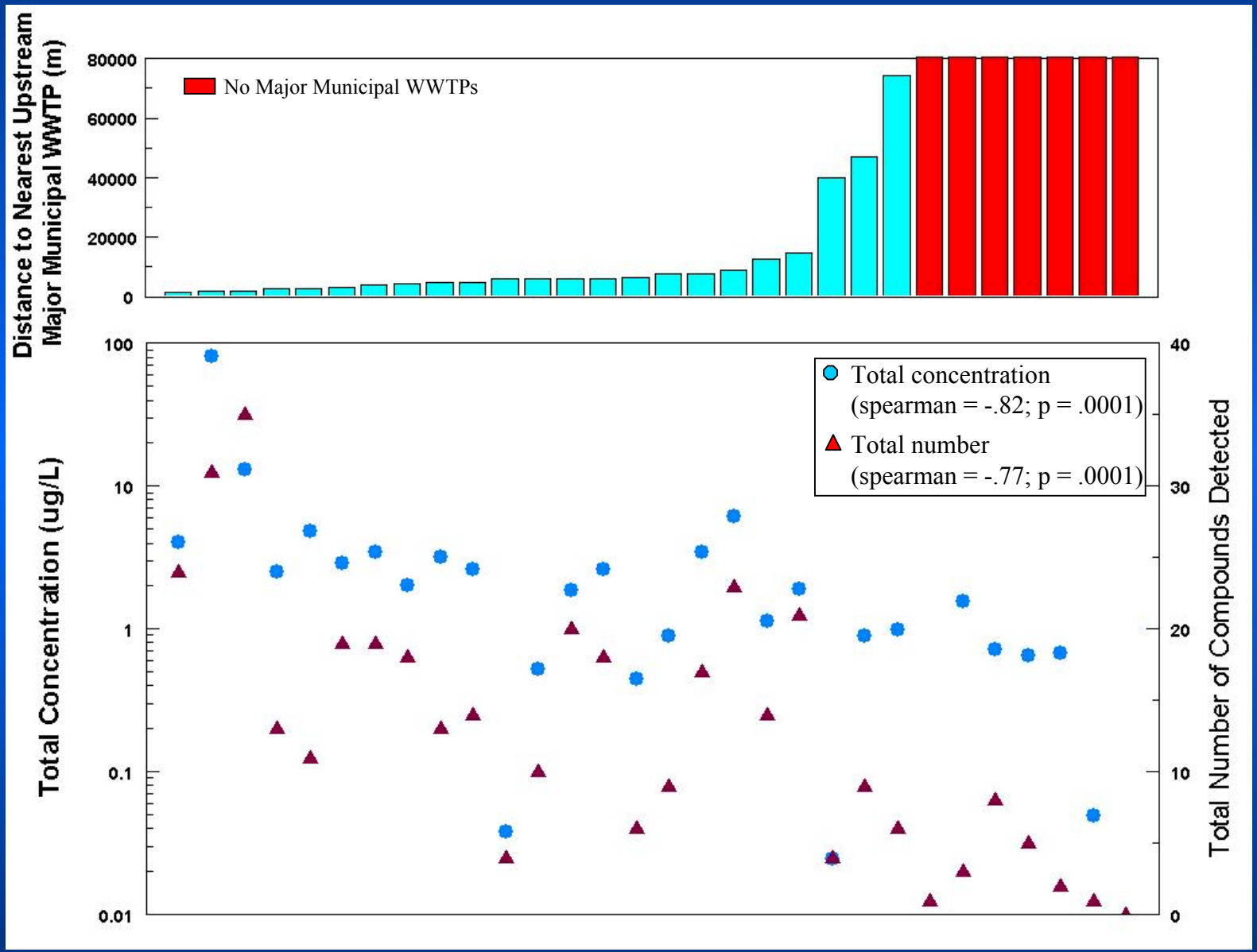
Co-occurrence



Primary Source



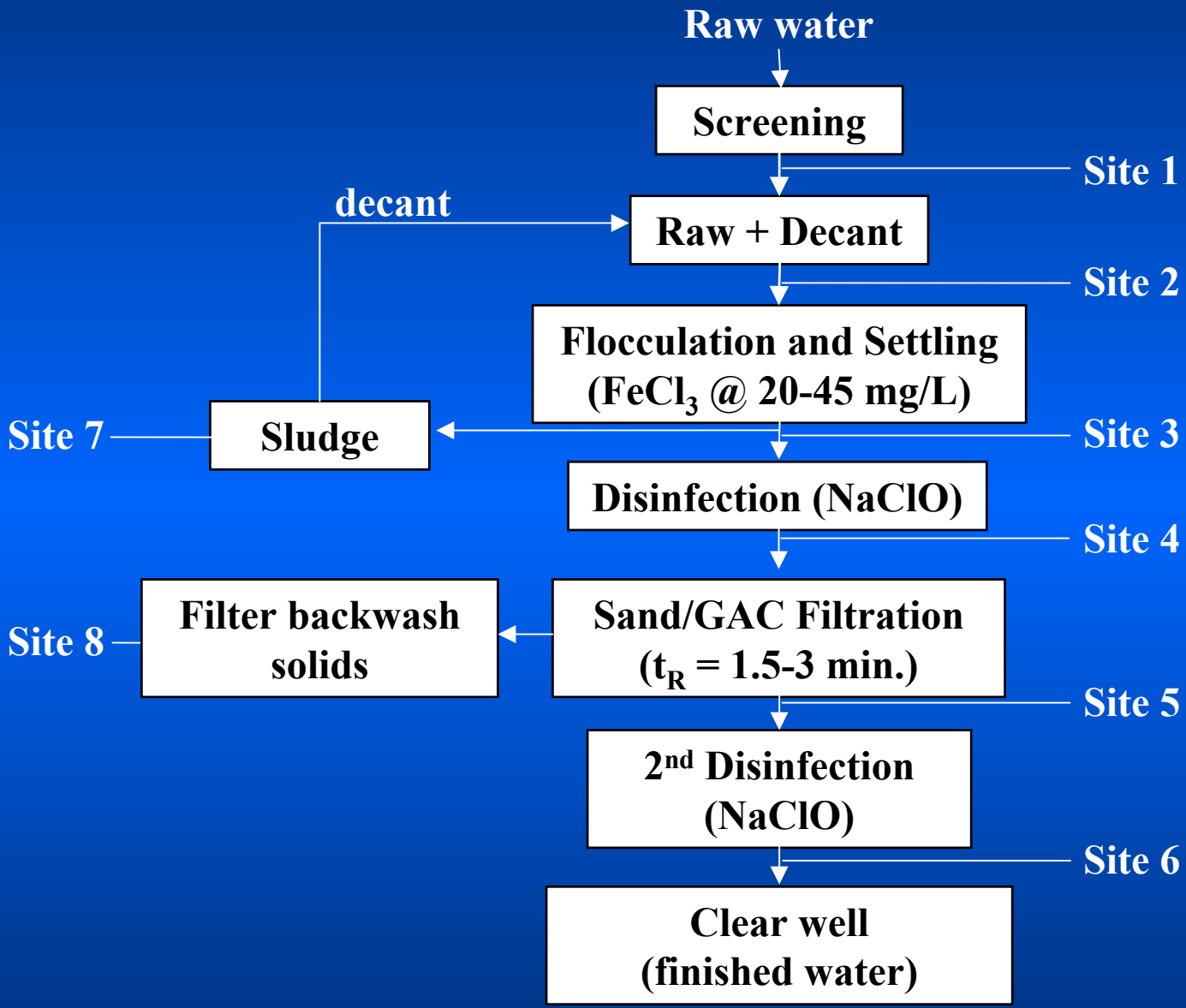
Fate And Transport



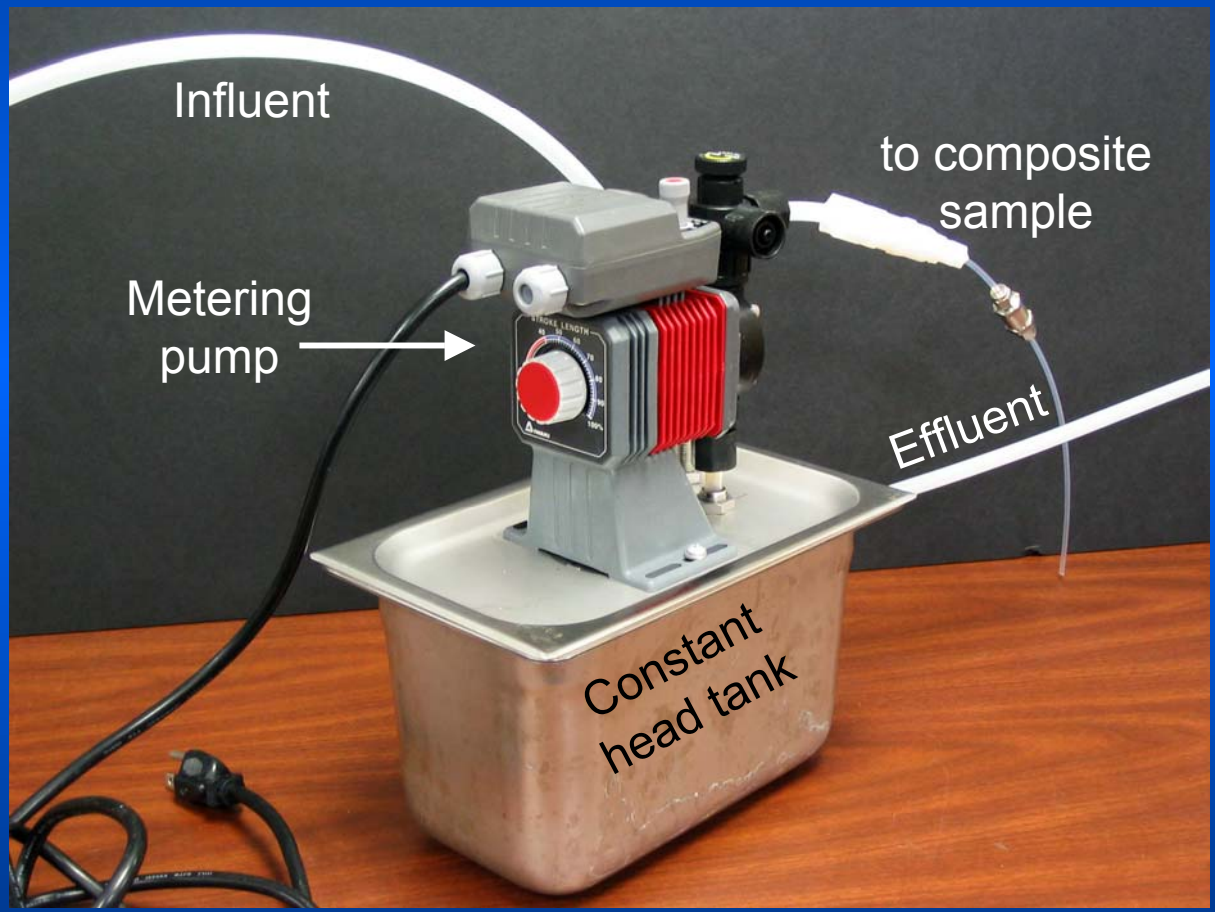
Fate of Unregulated Organic Compounds in a Drinking-Water-Treatment Plant

Identify the primary physical/chemical processes that govern the fate of OWCs through conventional water treatment

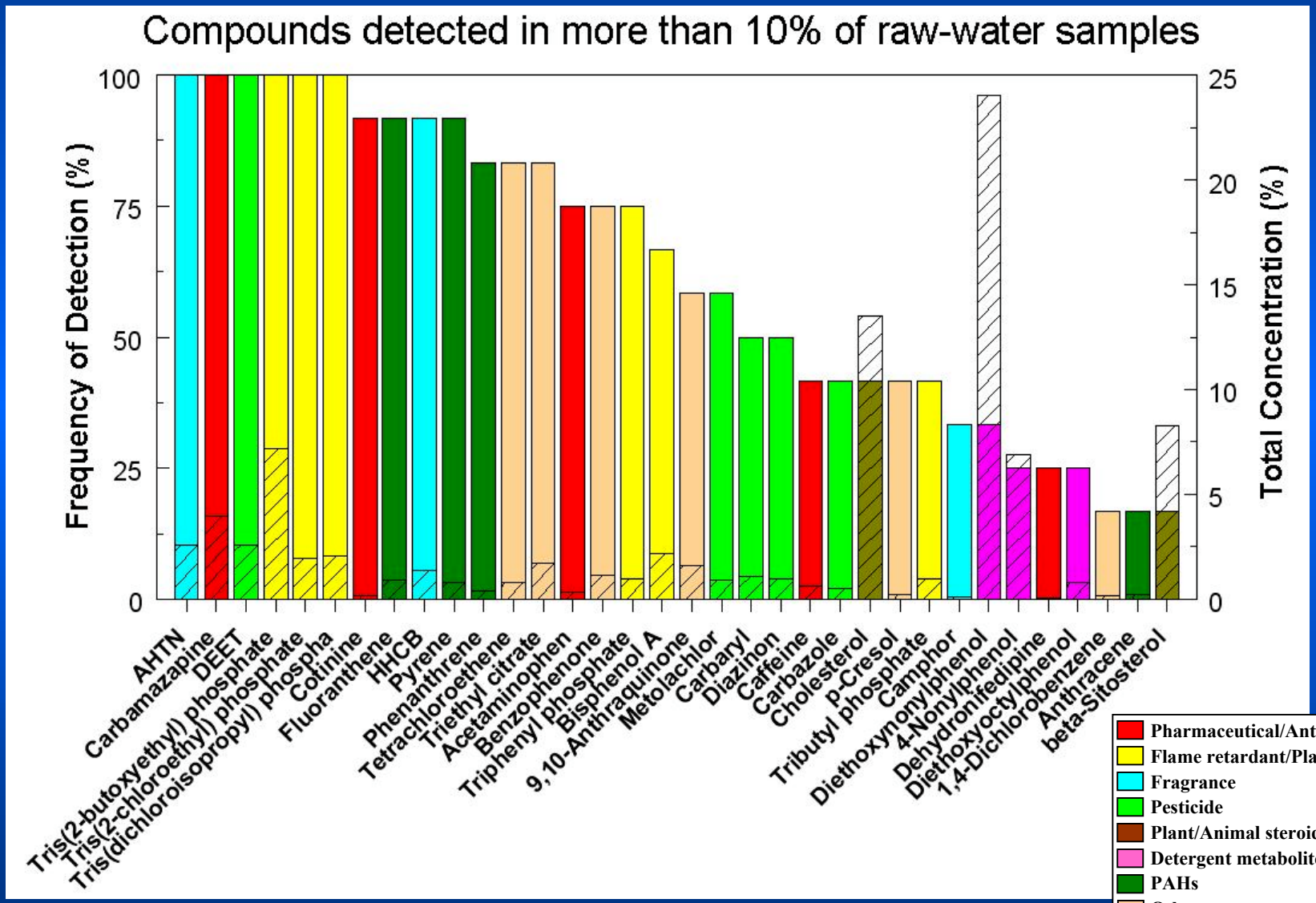
Plant and Study Design



24-hour Composite Water Samples

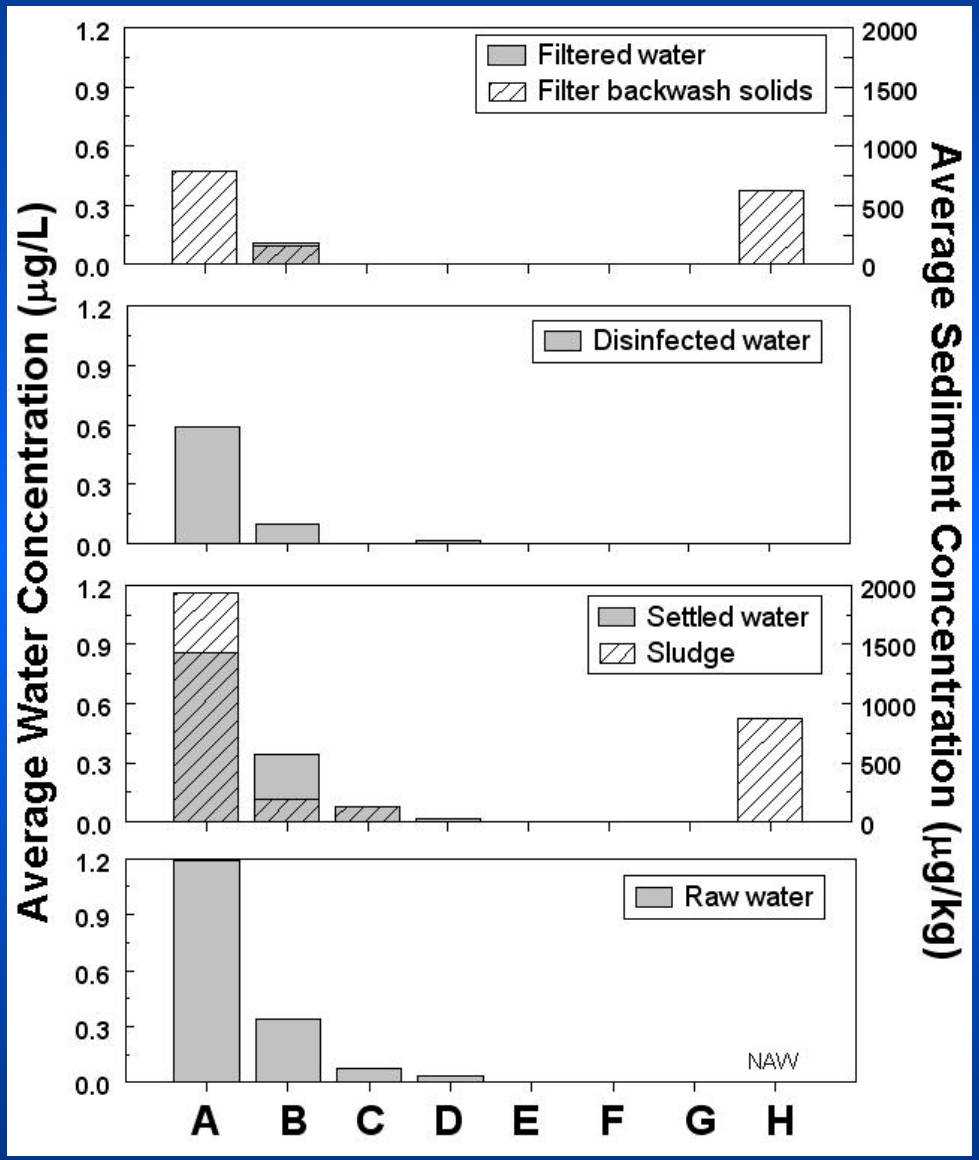


Most Frequently Detected Compounds in Samples of Raw Water



Preliminary/Provisional Results – Subject to Revision

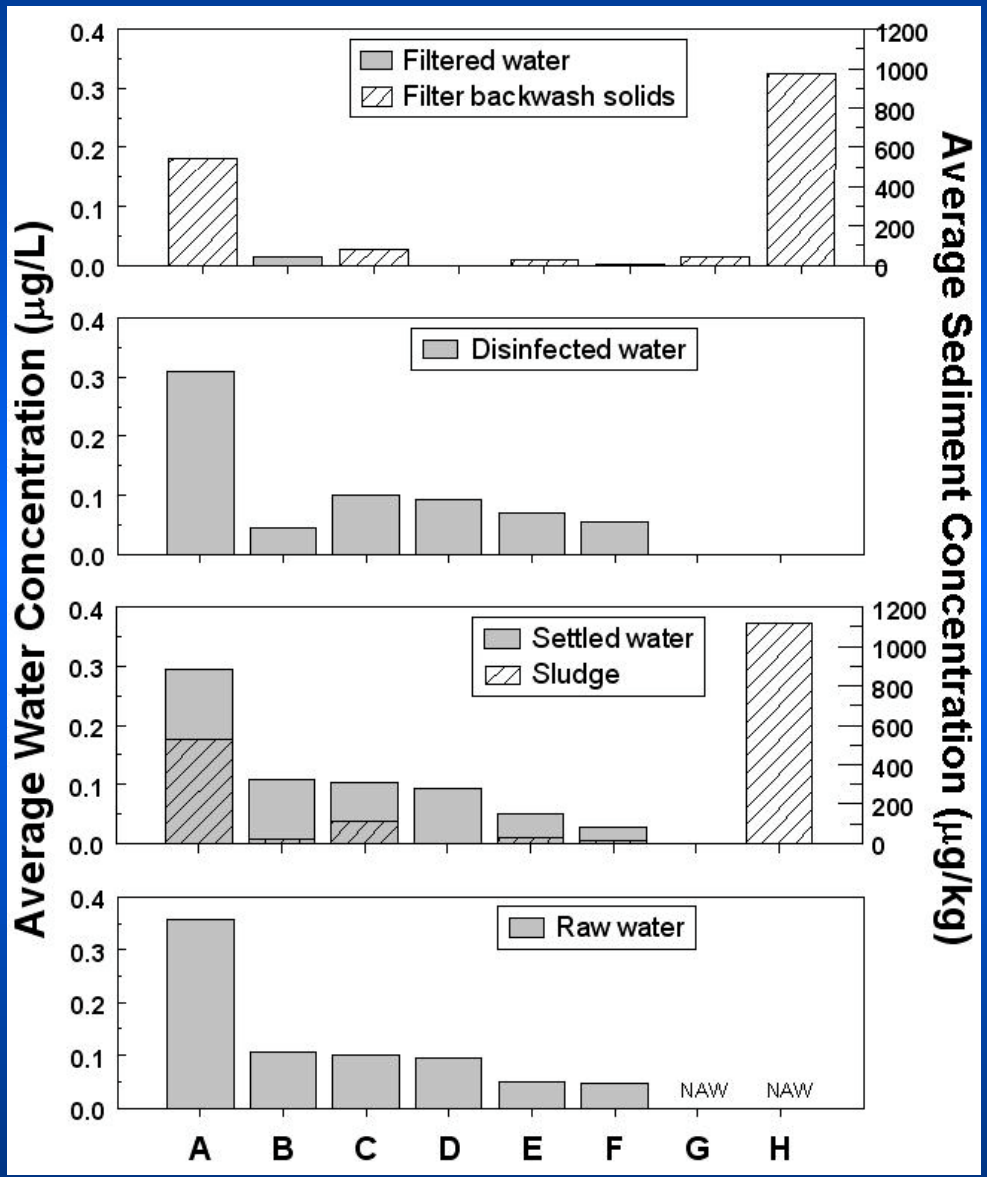
Fate – *detergent metabolites*



Explanation

- Diethoxynonylphenol
- 4-nonylphenol
- Ethoxyoctylphenol
- Diethoxyoctylphenol
- 4-cumylphenol
- 4-octyphenol
- 4-*tert*-octylphenol
- Monoethoxynonylphenol

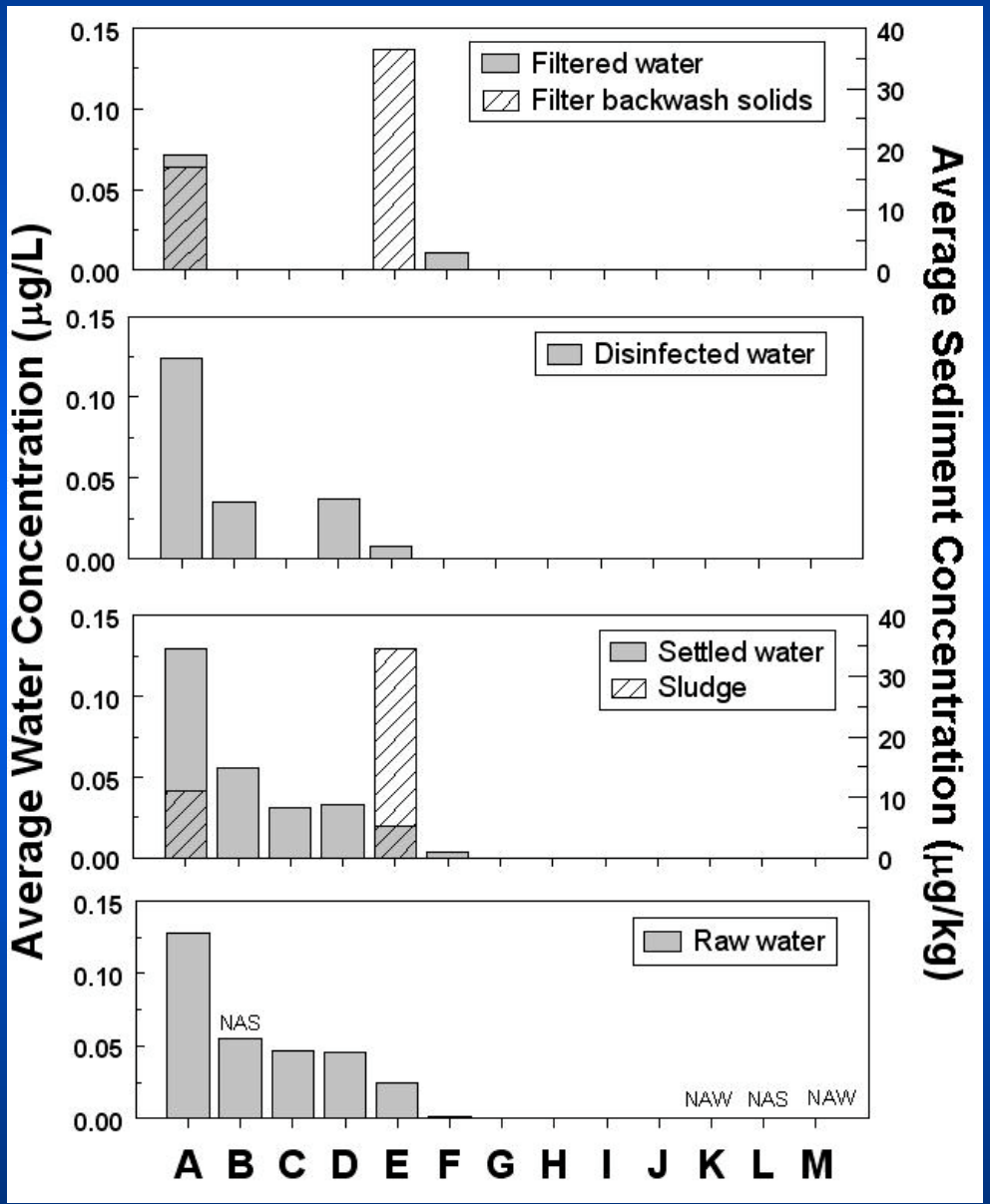
Fate - *Flame Retardants/Plasticizers*



Explanation

- Tri(2-butoxyethyl) phosphate
- Bisphenol A
- Tri(dichloroisopropyl) phosphate
- Tri(2-chloroethyl) phosphate
- Triphenyl phosphate
- Tributyl phosphate
- Diethyl phthalate
- Diethylhexyl phthalate

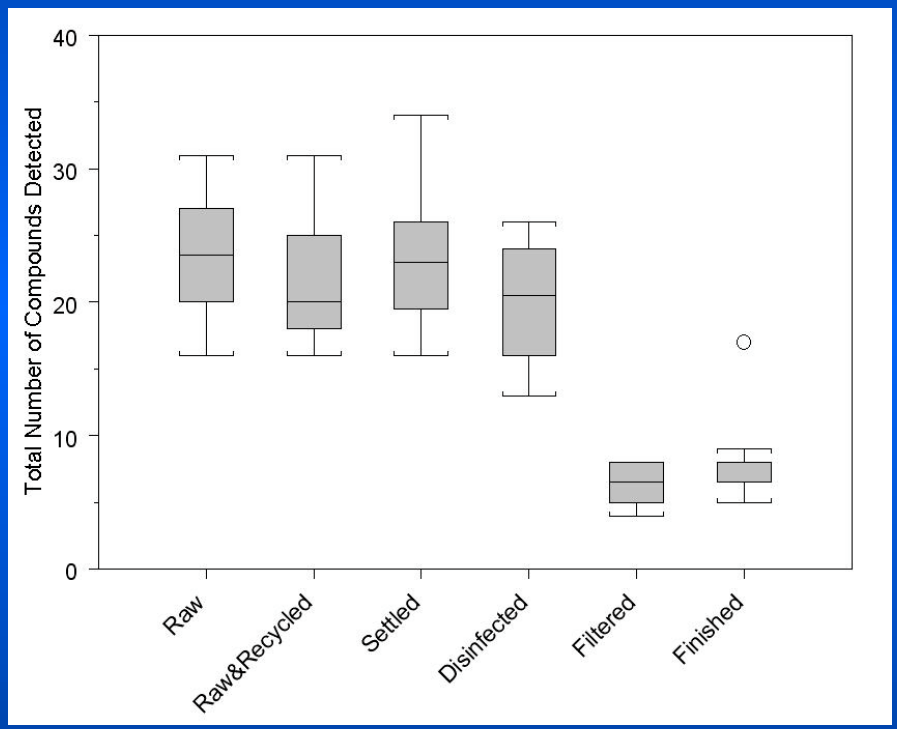
Fate - *Pesticides*

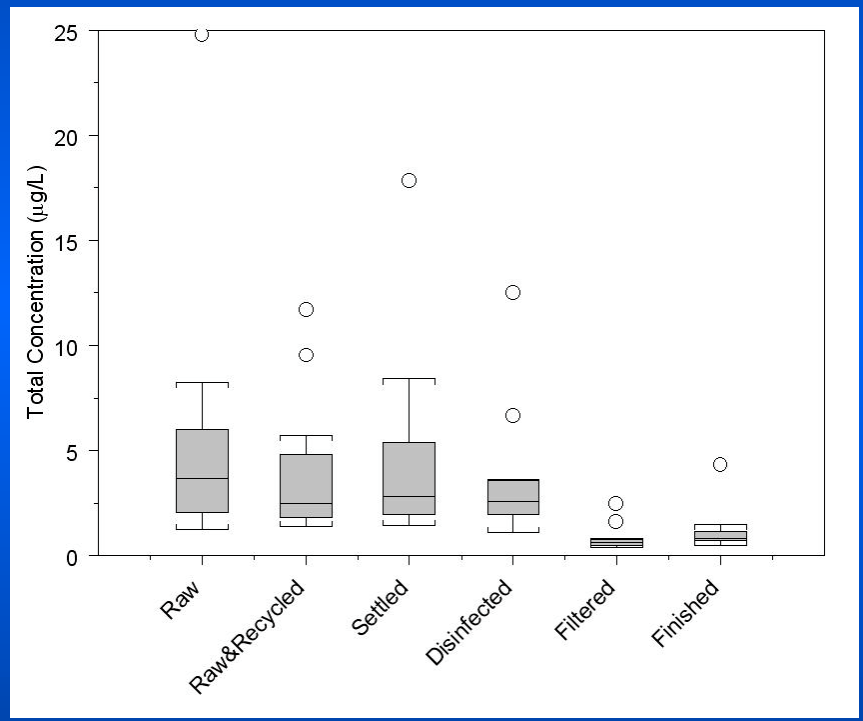


Explanation

- DEET
- Carbaryl
- Diazinon
- Metolachlor
- Carbazole
- d-Limonene
- Bromacil
- Chlorpyrifos
- Metalaxyl
- Prometon
- Atrazine
- Dichlorvos
- 3,4-dichlorophenyl isocyanate

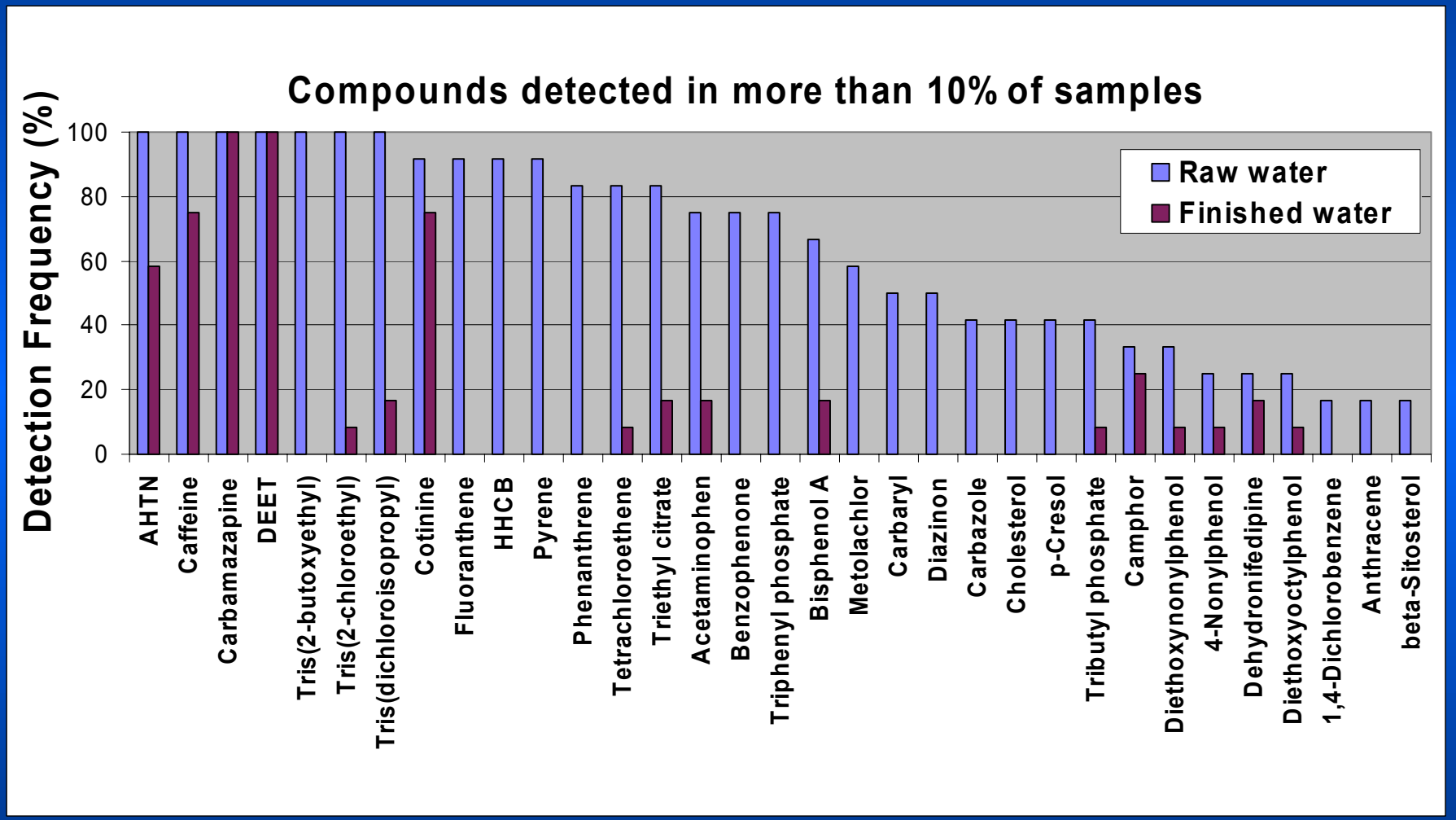
Total Number and Concentration per Sampling Site





Preliminary/Provisional Results – Subject to Revision

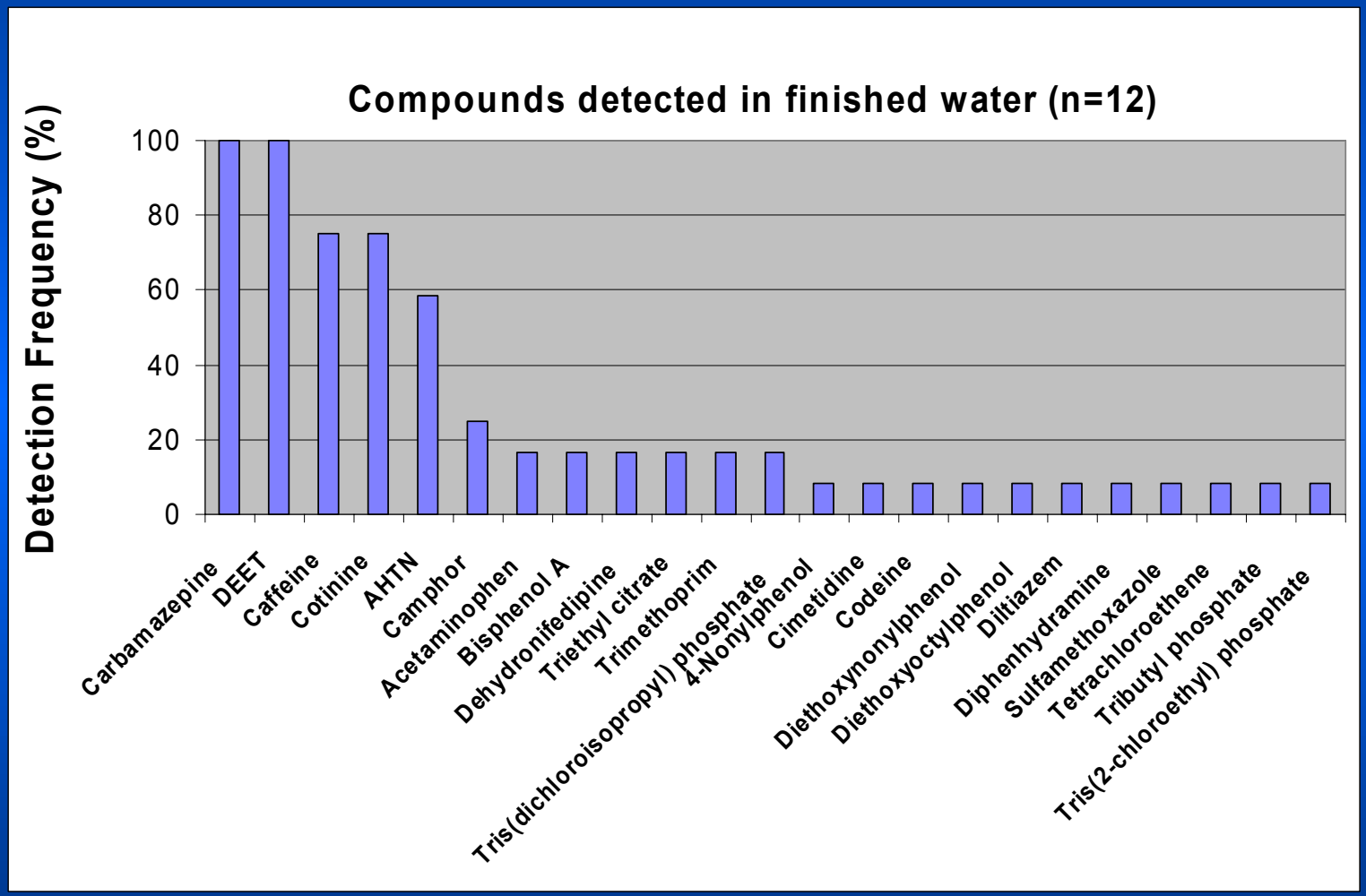
Occurrence in Raw and Finished Waters



Preliminary/Provisional Results – Subject to Revision

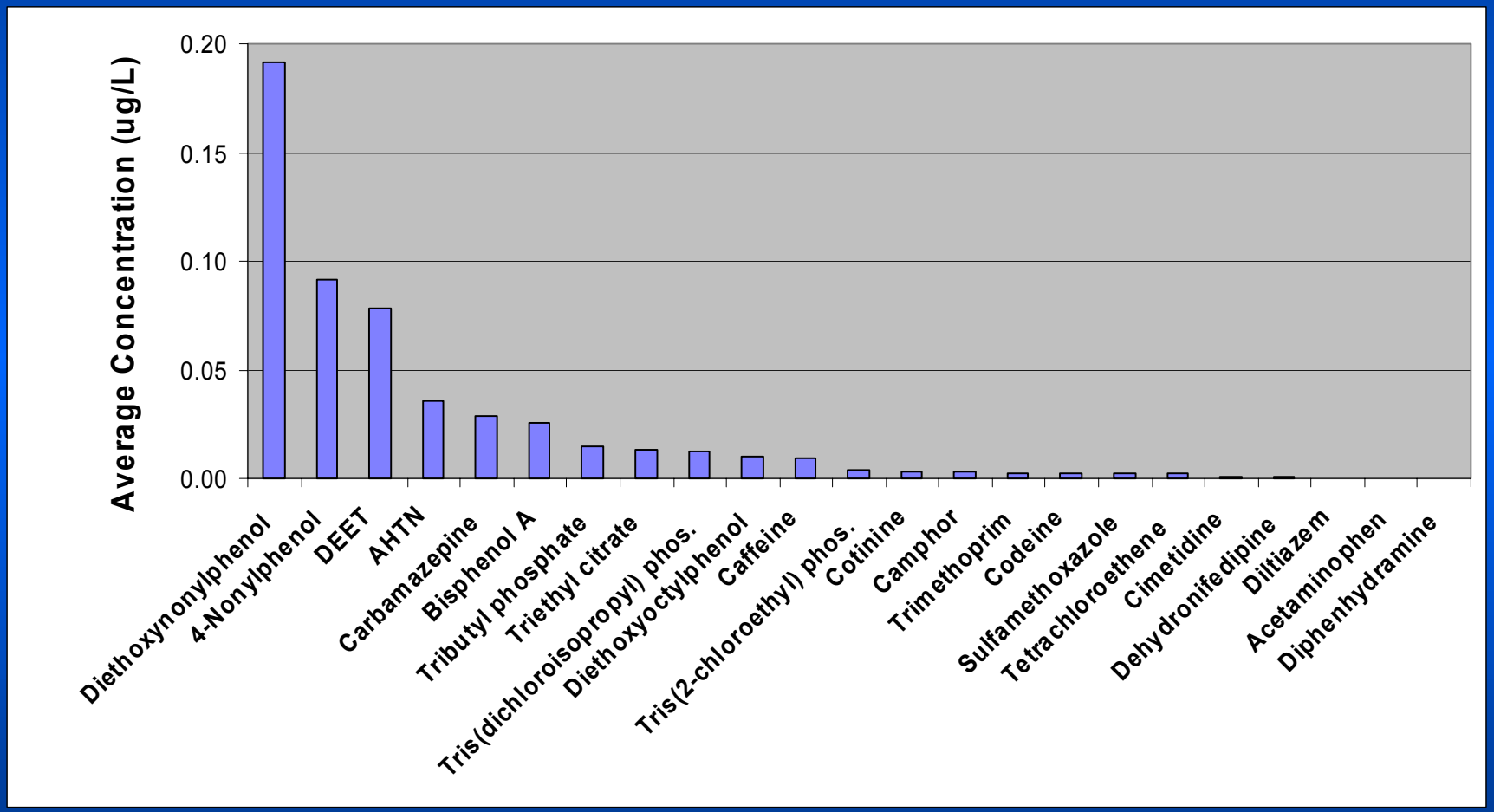
Occurrence in Finished Water

5 to 17 compounds detected per sample

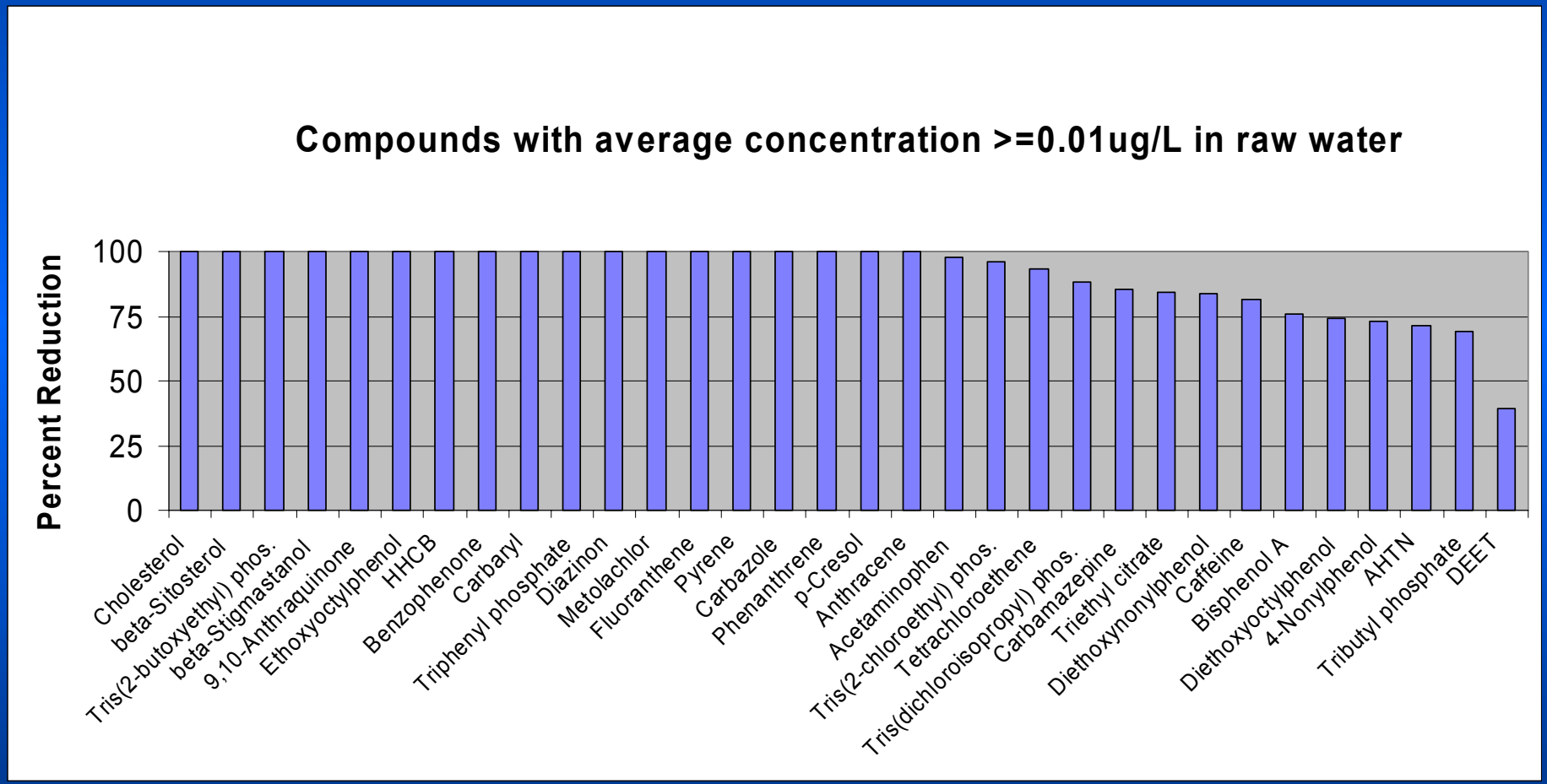


Preliminary/Provisional Results – Subject to Revision

Concentration in Finished Water



Percent Reduction in Concentration from Raw to Finished Water



Major Findings

- OWCs frequently detected in streams with effluent from STPs,
- Fate of OWCs through treatment process:
  - Removed with solids,
  - React with free chlorine, and/or
  - Persist to finished water
- Removal rates ranged from 40 – 100%,
- 5 – 17 compounds detected in samples of finished water.

Web Resources

- USEPA Office of Research and Development
  - National Exposure Research Laboratory
    - 'Pharmaceuticals and Personal Care Products (PPCPs) as Environmental Pollutants'
    - www.epa.gov/esd/chemistry/ppcp

- USGS Toxic Substances Hydrology Program
  - Emerging Water Quality Issues Investigations
    - 'What's in our Wastewaters, and Where Does it Go?'
    - toxics.usgs.gov/regional/emc.html

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